3.0 DESIGN BASIS

This section details the basis for the OE remedial design. The extent of the OE removal/remediation, site safety, environmental controls, regulatory considerations, public safety, technical approach, and data management for the detection and mapping of OE, OE point clearance, and areawide clearance are described.

The OE remediation was designed assuming that OE could be encountered in any soil area within the Project Site (lateral and vertical). In addition, the remediation design takes into consideration the future land use for the site, capabilities of current detection technologies, and required phasing of project activities. The future land use for the site is planned open space and residential use (see Figure 1-5). Because current detection technologies cannot guarantee 100-percent detection rates at depth, multiple geophysical scans using the best available technology and methods, soil excavation and rescanning activities as the material is placed in the North Valley was selected as the remedial design in residential areas. In addition, the soils derived from area wide clearance will be overlaid by a minimum of 14 feet of OE-free, crushed bedrock from the Ridge. For open space areas and in areas where pavement, sidewalks, and utilities are currently in place in Unit D-1 and the McAllister Drive Land Bridge, institutional controls will be implemented to limit subsurface disturbance without proper OE safety specialist support.

Soil mixtures with 10 percent or more explosives by weight are also considered OE. The design basis for the remediation of explosive soils was to find a safe and effective way to allow the TNT-affected soil to be excavated and transported from the Project Site to an appropriate landfill. Addition of water and discing (homogenization) to eliminate the heterogeneous high concentration (crystalline structure) and the explosive potential in the soil was selected as the remediation method. As determined by the analysis of alternatives in the draft final RI/FS report (Earth Tech, 2001), homogenization of explosive impacted soil would be the most effective way to reduce the reactivity of the soil to safe levels for handling.

Phasing of the project was influenced by several factors. The relocation of soil to the North Valley cannot occur until after completion of non-OE remediation. Point clearance of Unit D-1 (Sectors 1 and 2) and a 200-foot MSD from Unit D-1 (Sector 3) has been phased early in the sequence of events to allow the early construction start for homes in Unit D-1 before OE remediation is completed on the remainder of the Project Site. In addition, point clearance on a portion of the South Valley (Sector 4) will be phased in the project sequence to reduce impacts on residents and to the Matthew Turner Elementary School from voluntary evacuations when school is in session.

3.1 EXTENT OF REMOVAL/REMEDIATION

It has been assumed that OE should be expected in any soil area within the Project Site boundaries. However, the greatest likelihood of detecting OE is expected to occur within or near areas of the Project Site that have been used for demilitarization of OE by DOD. A preliminary site conceptual model (SCM) based upon the results of previous OE investigations is shown on Figure 3-1. A final site conceptual model will be developed that is based on data collected during the point clearance phase of this OE investigation and remediation and the work at the Former Benicia Arsenal, which began in May 2001. Horizontal distribution of OE resulted from OE or OE scrap being expelled or “kicked out” from a demolition site during disposal operations.

Vertical distribution of OE through the soil column is dependent upon how the Project Site was used by DOD. There are two suspected demolition sites (Demolition Sites #1 and #3) and a Flare Site in the South Valley (see Section 1.5.4). There was a Howitzer Test Facility where inert artillery rounds were fired into test tunnels. There were no artillery ranges and/or bombing activities at the Project Site. Therefore, there has been no OE found that penetrated as a result of ballistic trajectories anywhere on site.

All subsurface OE has been buried either by natural process or by man or has been expelled or kicked out from demolition activities. OE outside Demolition Sites #1 and #3 in undisturbed areas would be expected to be distributed in the top 1-2 feet of soil. This finding is consistent with the data collected in the Former Benicia Arsenal EE/CA and the maximum penetration depth for a 37mm and 60mm based on the impact velocities for a free-fall height of 500 feet. Based on this information, two conclusions have been made: (1) OE outside the defined demolition sites in undisturbed areas would be relatively shallowly buried below the surface (i.e., less than 2 feet bgs); and (2) OE could not be present within the bedrock at the Project Site; therefore, bedrock is considered to be free of OE.

No federal or state requirements (i.e., ARARs) have been promulgated that prescribe OE remediation levels in soil. Therefore, remediation goals have been conservatively developed in this OE RDD to allow unrestricted development of the planned residential areas of the Project Site and to remediate open space areas to acceptable levels. Risk-based cleanup goals were developed for TNT and are presented in the draft final RI/FS report.

In order to meet the OE remediation goals for the Project Site, a two-step approach was developed to (1) remove all detectable metallic anomalies down to the limit of the equipment detection over the entire Project Site, except paved areas of Unit D-1 and McAllister Land Bridge and areas where soil will be excavated and scanned in lifts such as the identified demolition sites and fill areas; and (2) geophysically scan and remove surficial soils in residential areas that potentially could contain undetected OE (areawide OE clearance) and scan again after placement in the North Valley; until two OE and OE scrap-free lifts or bedrock are obtained. In the demolition site areas the excavation and scanning in lifts will be continued until bedrock is encountered.

The extent of areawide OE clearance within the residential areas will be determined by an evaluation of the point clearance data. The distribution of OE and OE scrap will be analyzed to identify patterns of OE and OE scrap and assessed to determine whether or not these patterns are considered to be kicked out of demolition sites. The distribution of OE and OE scrap will be used to define the extent of the areas where areawide clearance is required. If an OE item is not associated with a pattern, it will be considered an outlier, and a 200-foot-radius additional scan area around the location of the OE item will be identified. Areawide clearance will be conducted within the 200-foot radius if it is within a future residential area.

3.2 ENVIRONMENTAL CONTROLS

Environmental control criteria included in this OE RDD address the following:

- Air quality monitoring
- Noise abatement
- Excavation and erosion control
- Storm water runoff control.

3.2.1 Air Quality Control

The City of Benicia is in the BAAQMD jurisdiction area, which encompasses the San Francisco Bay Area Air Basin (SFBAAB). The SFBAAB is designated as a nonattainment area (California Ambient Air Quality Standards [CAAQS]) for ozone and for particulate matter equal to or less than 10 microns in diameter (PM_{10}). Monitoring of Project Site boundary concentrations of airborne dust (PM_{10}) will be performed during all Project Site excavations in chemically affected soil areas (Flare Site, Demolition Sites #1 and #3, and the TNT Strips) and during detonations.

To conduct the monitoring, a total of three PM_{10} monitors will be used, where:

- One monitor is placed at the upwind Project Site boundary

- Two monitors are placed at least 100 feet apart along the downwind Project Site boundary.

The predominant wind direction prevails from the west. However, wind conditions will be assessed continually during site activities to determine if monitoring locations need to be modified. Mean wind speeds range from 7 to 14 miles per hour (mph). Sample filters will be recovered each day monitoring is performed and placed in appropriate labeled containers indicating the date, sample location, sample collection time (total plus on/off times), and total air volumetric flow through the sampler. Samples will be sent off site for measurement of total collected mass (gravimetric analysis), which will be used to determine average dust concentrations at the upwind and downwind boundary monitoring locations

If results from any day show that any downwind concentration (minus upwind background concentration) exceeded 0.15 milligrams per cubic meter (mg/m^3), the Site Safety Officer (SSO) will be contacted to determine if work procedure modifications, improved emission controls, or revised work site monitoring procedures are warranted.

In order to control off-site emissions, work area monitoring will be performed to assess and control airborne dust emissions.

Monitoring will be performed using a real-time aerosol monitor capable of accurately measuring airborne dust concentrations to less than 1 mg/m^3 (MIE Model pdm-3 Miniram or equivalent). Readings will be taken at the work area where excavations in chemically affected soils are occurring at 30-minute intervals and recorded in the field log book. Reading locations will include, at a minimum:

1. The location 25 feet upwind of the active work area (baseline concentration).

2. The location 10 feet downwind of the active work area.

3. The equipment operator’s breathing zone.

4. The breathing zone of one other worker near the active work area.

The baseline concentrations result (upwind location) will be subtracted from each of the subsequent readings, and the results will be used to determine whether dust control measures are adequate, based on the following:

Dust Concentration Above Background	Response
0 – 1.0 mg/m^3	No action required.
1.0 – 1.5 mg/m^3 measures	Implement additional dust mitigation
	(see Addendum 1 Section 5.4)
> 1.5 mg/m^3 (two consecutive readings)	Cease work until emissions can be controlled to less than 1.0 mg/m^3

In addition, at 30-minute intervals, an assessment will be made of the Project Site boundary conditions at all areas downwind of active work locations. No visible dust emissions are permissible leaving the Project Site boundary at any time. Failure to meet this criteria will necessitate work stoppage until environmental conditions (wind speed/direction) or operational procedures will allow work without visible emissions at the boundary.

Since inhalation exposure of chemicals is related to dust emissions, the following requirements will be implemented at all times.

1. Active soil stockpiles and active excavation areas will be wetted using water. Sufficient wetting will be used to control dust emissions to acceptable levels.

2. When not active, soil stockpiles will be covered with plastic sheeting or a similar material. All piles will be covered at the end of each work day.

3. Soils will be carefully dumped/handled to minimize dust emissions. Dumping at heights greater than 2 feet is prohibited when loading trucks.

4. Haul roads will be watered at least once each hour, or more frequently if roads are observed to be dry or if visible emissions are produced by normal vehicular traffic.

In the event that on-site monitoring indicates the excessive release of dust, one or more of the following mitigation procedures will be implemented:

1. Additional water will be placed onto active surfaces to wet soils.

2. The work rate will be reduced to reduce emissions.

3. Excavation equipment will be replaced with other equipment to reduce emissions.

If mitigation measures are ineffective, work operations will stop and the Health and Safety Officer (HSO) will be consulted for additional guidance.

3.2.2 Noise Abatement

The project includes three operations that could result in noise impacts: (1) brush and vegetation removal by gas-powered weed cutters and tractor-pulled mowers; (2) heavy equipment operations during OE point and areawide clearance; (3) other grading activities; and (4) detonation of OE.

All heavy equipment will be equipped with mufflers and air intake silencers to reduce noise emissions. Hours of operation will be limited to working hours (7:00 a.m. to 5:30 p.m.). Maintenance of construction equipment may occur up to 10:00 p.m. During a BIP detonation, noise monitoring will be conducted at the Project Site boundary and/or the property lines of the residences nearest the detonation.

Noise levels generated by Project Site activities will not exceed the Noise Level Performance Standards contained in the City of Benicia's noise ordinance (Chapter 8.20.010).

3.2.3 Surface and Groundwater Contamination Control

The size of the Project Site and the nature of the proposed activities do not present the potential for depletion or degradation of groundwater, nor will they affect groundwater recharge. During project activities, there is no long-term requirement for water usage. Water will be brought on site for dust suppression and soil compaction.

A storm water pollution prevention plan (SWPPP) will be developed prior to excavation activities. The SWPPP will include a plan drawing of the Project Site showing where specific types of erosion and sediment control measures will be used, detail drawings of each measure, and a list of specifications on how each measure is to be implemented. Surface drainage at the Project Site will be controlled as detailed in the SWPPP to reduce the potential for erosion as a result of project activities.

3.2.4 Excavation and Erosion Control

Unstable earth conditions resulting from OE point clearance excavations will not be significant because the depth of the excavations is not expected to exceed 2 feet in any of the grid locations, with the exception of the demolition sites. Erosion control requirements will be implemented as required by the approved Grading Plan and the SWPPP.

Use of silt fences downslope of excavation areas will reduce movement of sediments into wetland areas. Soil stockpiles potentially containing chemicals of potential concern will be placed on, and covered with, non-permeable plastic sheeting to separate these soils from underlying soils-bedrock.

3.2.5 Grasslands and Jurisdictional Wetlands

Figure 3-2 shows the areal extent of the delineated jurisdictional wetlands within the Project Site boundary. Prior to beginning any work, the CDFG will be notified of the proposed activities through the Notification of Lakes and Streambed Alteration Form FG2023 and Project Questionnaire Form (FG 2024). CDFG will notify project proponents if a permit is needed.

Vegetation clearance adjacent to the wetlands, hand-excavation of anomalies, and BIP activities in and around the wetlands will require control measures to prevent erosion (detachment of soil particles) or control the movement of mobilized sediment.

The project will implement regular maintenance activities to prevent soil, petroleum products, and litter from accumulating on the Project Site and degrading water quality through surface runoff. Fueling areas will be designated on maps and situated at least 50 feet from all drainages and 300 feet from wetlands. Construction debris will be placed in a designated area away from the aquatic habitats to prevent wind- or water-borne debris from entering the water bodies.

A qualified biologist will review grading plans, mark sensitive habitats on maps, and flag all sensitive habitats that are to be avoided, prior to the onset of construction. A contractor education program will be implemented to ensure that the contractors and all construction personnel are fully informed of the biological sensitivities associated with the Project Site.

A survey will be conducted by a qualified biologist to determine if grassland avian species or tricolored blackbird (*Agelaius tricolor*) nesting sites are present. Any nesting locations will be flagged and destruction of such sites will be avoided to the maximum extent possible. Construction activity near these locations will be avoided until the nesting period is over and the young have left their nest.

Exposed slopes will be hydroseeded. Seeding mixtures and types of plant species to be seeded will be coordinated with CDFG by the project proponent. Following completion of project activities, the drainage area supporting the South Valley wetlands will be restored to reestablish marsh and riparian vegetation similar to the one that has been disturbed or lost.

Following completion of all remediation activities on the Project Site, the proponent will implement a mitigation program approved by USACE (Regulatory) to compensate for the loss of approximately 0.215 acre of the North Valley and South Valley seep jurisdictional wetlands. A wetlands replacement ratio of 2:1 may be implemented as compensation.

3.3 SITE WORKER AND PUBLIC SAFETY

3.3.1 Minimum Separation Distance

The OE Site-Specific Safety and Health Plan (SSHP) (Appendix F) provides strict safety procedures for site activities to ensure that the remediation is conducted in compliance with applicable safety regulations. The OE SSHP requires the establishment of an MSD around the work area to provide safety to support personnel and the public during OE remediation activities. The MSD is the distance beyond which personnel, except for personnel conducting the proposed activities, withdraw for safety purposes. The MSD is based on an accidental detonation on the ground surface in which no engineering controls are in place. The MSD may be larger than is required for intentional detonations where use of engineering controls will contain the fragments and reduce the associated noise and dust. The MSD is 200 feet, based on the most probable munition (MPM) of a 37mm HE projectile and the 60mm HE mortar (U.S. Army Corps of Engineers, 2000) (Figure 3-3). The MSD is based on USACE's *Methods for Calculating Range to No More Than One Hazardous Fragment per*

600 Square Feet (HNC-ED-CS-S-98-2) for accidental detonations. If, during the course of the OE remediation it is determined that a different MPM is appropriate, all intrusive operations would cease and the USACE Safety Specialist would be notified. A new MSD would be determined and an amendment to this OE RDD shall be submitted for approval. Until this amendment is approved, the specified default distances in DOD 60559-STD, Chapter 5, Table C5.T.1 will be used.

Additionally, remediation of TNT-affected soil with TNT concentration of 10 percent or more by weight will require an MSD of 412 feet, based on blast distance calculations derived from the potential net explosive weight of TNT in the soil. These calculations are based on the procedures included in "Ammunition and Explosive Safety Standards," Department of the Army Pamphlet PAM 385-64. These calculations are provided in Appendix G.

The MSD must be maintained during OE surface clearance, the excavation of OE-related anomalies, disposal of OE, and homogenization of TNT-affected soils with a TNT concentration of 10 percent or more by weight. Only OE crews, geophysical crews, and other support crews that are essential to the OE remediation on the Project Site will be allowed within the MSD. However, a safe separation distance of not less than 200 feet must be maintained at all times between the various work crews.

3.3.2 Minimum Separation Areas

Because of a potential for an accidental or intentional detonation that could cause an impact to on- and off-site personnel and the public, an MSA based on the MSD will be established to identify areas where the public and nonessential personnel will be excluded during OE excavations. The MSA includes the surface area within the radial MSD of the OE excavations. An MSA will be established each work day for OE surface clearance and all excavations to be completed during the day. Each daily MSA will be defined using the following criteria:

- The number and location of grid to surface cleared or anomaly excavations affecting a specific off-site area

- The number and location of grids to be surface cleared or the anomaly excavations to be completed during an 8-hour work period

- The number of available OE crews.

The MSA will be maintained during the execution of OE surface clearance or OE anomaly removal activities and excavation of TNT-affected soils containing concentrations of explosives of 10 percent or more at the Project Site.

3.3.3 Voluntary Separation Distance

Residents and businesses outside an MSA, but within the distance that fragmentation could conceivably travel in the event of an accidental detonation, will also be notified of the potential hazards associated with clearance activities at distances beyond the MSD. The applicable distances for this broader notification, or voluntary separation distance (VSD), will be based on the maximum distance a fragment could travel in the unlikely event of an accidental detonation. For this project, USACE has calculated 1,080 feet for the 60mm HE mortar and 1,181 feet for the 37mm HE projectile as the maximum fragmentation distance for these items. Notification will include a public meeting to be held prior to mobilization for the field effort and specific notification prior to work within an area where homes, businesses, or schools would be within the VSD of OE surface clearance activities or an intrusive OE operation, in accordance with the MSAP (see Appendix B). The VSD for the Project Site is shown on Figure 3-4. These distances will remain constant unless site data collected during remedial activities indicate that a different munition should be used to establish the MSD and VSD.

3.3.4 Mandatory Public Withdrawal

Land areas bordering the Project Site that could be affected by the initial MSA are shown on Figure 3-3. Resident within the designated MSA will be required to vacate during OE excavation activities, but residents will be able to return to their homes at the end of each work day. The public withdrawal and relocation of residents within the MSA will proceed as detailed in the MSAP (Appendix B). OE clearance activities will be conducted over the entire Project Site. As currently extended, the mandatory MSA will affect approximately 191 homes (see Figure 3-3). Each home may be affected for 1 day during OE surface clearance and a period of up to 8 days during OE intrusive investigations. An example daily evacuation area is shown in Figure 3-5.

3.4 TECHNICAL APPROACH

The entire Project Site will be geophysically scanned and all detected anomaly sources will be excavated and removed. In Demolition Sites #1, #3, the Flare Site, fill areas in the North Valley, and the fill area in Unit D-1 where the potential for OE may be greater at depths, the soils will be scanned, cleared of anomalies, and excavated in lifts to remove all detected anomalies. In addition, all areas of the Project Site where OE and OE scrap were detected will be evaluated to determine the area's potential to contain OE. Based on the results of this analysis, further scanning and excavation of subsurface soils will occur in areas of the Project Site that are within a future residential area if the area is considered to have a potential to contain OE. Institutional controls will be implemented and maintained in open space areas of the Project Site and in the paved portion of the McAllister Drive Land Bridge and the paved portion of Unit D-1.

The sequencing of the removal/remediation activities has been planned to expedite completion of clearance activities in Unit D-1 and adjacent areas to allow commencement of an early construction start of Unit D-1. Completion of an OE removal/remediation in Sectors 1, 2, and 3 will create at least a 200-foot buffer between construction activities in Unit D-1 and OE remediation activities in the rest of the Project Site. Work on the west side of the South Valley will be scheduled to reduce impacts to the Matthew Turner Elementary School from voluntary evacuations. However, this is dependent upon the project start date and school schedule.

3.4.1 Surveying of Grids

Plastic or wooden hubs will be used for all basic survey control points. Horizontal and vertical control of "Class I, Third Order (1:1000)" or better will be established for the grid network of monuments. Horizontal control shall be based on the English system and referenced to the North American Datum of 1983 (NAD83) and the State Plane Coordinate Grid System. Vertical control shall also be based on the English system and referenced to the North American Datum of 1988 (NAD88). All control points (monuments, aerial targets, and property corners) recovered and/or established at the Project Site will be plotted at the appropriate coordinate point on a planimetric or topographic map at a scale of 1 inch = 200 feet (1:2,400).

3.4.2 Surface Clearance

Each grid will be cleared of surface OE and OE scrap. In addition, non-OE surface metallic debris that may interfere with the geophysical instrument will be removed. Identification and handling of these materials is described in Chapter 4.0.

3.4.3 Detection and Mapping of Ordnance and Explosives

Inductive time domain EM (TDEM) instruments will be used for this work because equipment tests previously conducted at the Project Site, as described in the EE/CA Work Plan for the former Benicia Arsenal showed that EM devices have greater detection capabilities than magnetometer systems (U.S. Army Engineering and Support Center, 1998b). Additionally, nonferrous OE such as World War II projectile fuzes, primers, burster tubes, and flare tubes is a significant concern at disposal sites (more so than on impact ranges); therefore, magnetometer systems are not being considered for use on the Project Site. The MTADS EM, MPA MTADS EM, and hand-held EM instrumentation (Geonics EM61-HH and White Pulse Induction metal detectors) will be used for the project. The operational limitations of these systems will be defined during equipment performance verification tests. TDEM systems are used to map the apparent conductivity of the ground and near-surface material. Discrete anomalies or peaks represent possible OE sources and can be mapped by tracking the position of the EM instrument along the traverse. Inductive EM geophysical methods are practical for locating isolated targets, as well as buried trenches and pits containing OE.

EM systems have been proven by both independent government evaluation and field implementation to be one of the most effective means for the detection of OE. With all geophysical instrumentation, the percentage of detection is a function of the size and depth of burial of the OE item being acquired. The larger and shallower the item, the more effective the TDEM technology will be in locating the item. The shallow burial depths across most of the Project Site lend themselves to higher detection rates.

TDEM data will be collected to discern anomalies for excavation. Tabulated anomaly lists will be reviewed by the project geophysicist prior to delivering dig sheets to the OE investigation teams. Once anomalies are identified in the data, the anomalies will be reacquired in the field.

For the OE point clearance phase, two digital geophysical surveys using an MTADS in accessible areas and an MPA MTADS in areas that are difficult to access will be completed for the entire Project Site. The second survey will provide a 100-percent QC check of the detection and mapping performance. The second geophysical survey mapping direction will be parallel (i.e., the same direction) to the first geophysical survey mapping direction. If an anomaly that is not a false-positive (i.e., an item is recovered from the location) is detected in the second scan, a third scan of that grid will be required.

The Naval Research Laboratory (NRL) has documented and explained the responses of the MTADS to the same target along orthogonal survey passes in *Electromagnetic Induction and Magnetic Sensor Fusion for Enhanced UXO Target Classification* (Naval Research Laboratory, 2000). The orientation differences derive from the directionality of the current field generated by the dipole transmitters of the EM systems with the result that the transmitter primary signal couples best with elongate conductive objects that have their major axis parallel to the lines of current.

The magnitude of the secondary field induced in the conductive object is directly determined by the strength of the coupled signal. The best coupling occurs when the major axis of the target source is vertical and the object is directly below the transmitter. Next best after the vertical alignment is coupling with an horizontal object under the edges of the transmitter with the major axis of the conductive body parallel to the field direction. For an EM61 transmitter (the MTADS is composed of multiple EM61s) this occurs when the long axis of the target lies perpendicular to the square loop transmitter of the system (i.e, parallel to the survey direction).

The data presented by the NRL indicate that the orientation of elongated targets, such as an 81mm mortar rocket or larger artillery projectile, can result in 30 to 40 percent variations in the geophysical responses amplitude, depending on the transverse direction over the target. Additionally, the shape of the geophysical profile plot over such ordnance will also be significantly different. The strength of the geophysical response to these OE is, however, great enough that 81mm and larger munitions are typically detectable at greater than 30 inches bgs, even for the least-coupled response.

Conversely, the results of the *Ordnance Detection and Discrimination Study* (ODDS) *Seeded Test Technical Memorandum, Former Fort Ord, California* (U.S. Army Corps of Engineers, Sacramento District, 2000) indicate that it is the proximity of the target to the transmitter array that is the dominant detection parameter for smaller OE , such as 37mm projectiles. To ensure detection of these smaller OE it is essential that complete coverage of the survey area is achieved. To accomplish this requirement, the transmitter/receiver footprint must pass over every portion of the search area. This is best accomplished by controlling the survey line spacing to ensure that some overlap occurs along the edges of each contiguous survey swath.

The MTADS proposed for the Tourtelot project has a 6.5 foot wide array comprised of three 3.28-foot square EM61 antennas interlaced such that there is 1.6 feet between the antenna coil centers. Deploying this system along survey lines spaced five feet apart provides 1.6-foot line spacings on the inside of the array track and 2.5-foot spacings along the track edges, yielding the requisite footprint overlap for optimal detection of small OE. The MPA MTADS consists of a single 3.28-foot-square transmitter/receiver. To obtain similar overlap with this system, the MPA should be deployed at no greater than 2.5-foot line spacings.

QC to assure complete coverage of the survey area will be achieved by ensuring proper line spacings are maintained. This will be accomplished by posting the centerline of the survey track (using a symbol size proportional to the required swath width) on a plot of the survey path and identifying all areas where the track centers of adjacent lanes are more than 2.5 feet apart. The geophysical survey teams would then return to collect fill-in data where these data gaps are identified.

As suggested by the ODDS test results, orthogonal surveys do not provide the same benefit for assuring the detection of smaller OE as can be gained by carefully controlled lane separations. Further, while an orthogonal survey will reduce target orientation/instrument coupling effects, it does not provide the means of checking the data quality in terms of repeatability, completeness, or appropriateness for detection of the intended targets. To properly validate the geophysical data, as well as the detection and disposal of OE requires that geometries be repeated. This is especially critical for smaller OE where a very subtle response in one directional may well be indistinguishable from the background “noise” response in an orthogonal pass over the same target source.

During OE point clearance activities, detection performance verification will be performed in 25 percent of the grids (each grid will be 100 feet by 100 feet) being cleared to verify actual field performance. This will be accomplished by seeding the grids with one or more inert items. Detailed performance criteria and QC measures to be used during geophysical mapping are presented in Chapter 4.0.

Detection performance verification will be performed using a test plot to determine the reliable scan depth, effective scan width, and optimal rate of scanning for each geophysical instrument package to be used at the Project Site. The reliable depth is defined as the depth at which a specific geophysical instrument detects 100 percent of the objects buried in the test plot that are equal to or larger than the size of interest (37mm HE projectile).

All geophysical instruments will be subject to detection performance verification as detailed in Chapter 4.0. Results of the verification test will be used to determine the maximum excavation depth for point clearance lifts and the maximum lift thickness for fill soils to be placed in the North Valley.

For planning purposes, a reliable depth of 1.5 feet has been assumed for the fieldwork described in Chapter 4.0 for MTADS and MPA MTADS geophysical equipment. Field procedures and lift thickness may require adjustments in the field based on the verification test results and the detection performance verification.

Data deliverables for geophysical field tasks include:

Daily

- Standardization data
- Field notes
- Data processing logs.

Weekly (5 days)

- Raw data, processed data, and interpreted data (target picks)
- Images of the digital data
- Data profiles over targets of interest
- QC auditQA summary.

These deliverables are discussed in detail in Sections 4.9 and 6.9.

3.4.4 Ordnance and Explosives Clearances

3.4.4.1 Existing Stockpiles.

Concrete, asphalt concrete, and other non-soil debris will be removed from the Unit D-1 stockpiles, Ridge Stockpiles #1 through #9, and Debris Stockpiles #1, #2, and #3 in the North Valley. The debris will be inspected by UXO personnel during loading and prior to being removed from the site. No scanning of the debris will be required. The debris that is removed will be disposed of off site at a materials recycler or suitable landfill.

For the Unit D-1 Stockpiles, if a soil stockpile is present, the soil will be sampled and analytical testing will be performed to assess the soil quality. The non-OE RDD provides details regarding sampling and analytical testing of soil. If the soils are chemically affected, the stockpile will be spread out on impermeable sheeting. These soils will be mapped with an MPA MTADS, and all anomalies will be removed. For the purposes of reducing the risk to equipment operators

and UXO technicians during the excavation, the cleared soil will be excavated to a depth of 6 inches less than the reliable depth of detection for the geophysical instrument. This process will be repeated until all soils have been scanned. These soils will be either temporarily stockpiled on site or transported off site to an appropriate landfill.
Stockpiles #1, #2, and #3 in the North Valley will be spread out on impermeable material. The soils will be scanned, and the anomalies will be removed. The cleared soil will be excavated to a depth of 6 inches less than the reliable depth of detection for the geophysical instrument. This process will be repeated until all soil has been scanned. Stockpiles #1, #2, and #3 will be transported off site to a suitable landfill for disposal.

After removal of debris from Ridge Stockpiles #1 through #9, the stockpiles will be graded flat to facilitate geophysical scanning and removal of anomalies. These soils will be mapped with MPA MTADS or MTADS, and the anomalies will be removed. The cleared soil will be excavated to a depth of 6 inches less than the reliable depth of detection for the geophysical instrument. The process will be repeated until the excavation encounters the bottom of the stockpile. The cleared soil may be temporarily stockpiled on site or may be transported off site to an appropriate landfill.

3.4.4.2 Point Clearance.

Following completion of the geophysical survey (digital data collection, processing, interpretation, and review), anomalies identified over the entire project area will be reacquired by the reacquisition teams in the field using MPA MTADS and intrusively investigated to discover the anomaly source. Field investigations will continue until the source for each anomaly has been found. The minimum excavation will be 36 inches wide and 18 inches deep. If no evidence of an anomaly is located when the minimum excavation is reached, the data will be reviewed by the project geophysicist and OE team supervisor(s). Anomaly data will be electronically recorded and will include:

- Description of the item (OE [OE scrap with explosive residue or other energetic material], OE-like item, OE scrap)

- Location (northing and, easting, or lat/long, surface, subsurface including depth)

- Orientation of intact items (relative to cardinal directions)

- Condition of item (evidence of demolition)

- Area of site (sector, demolition pit, fill, native material)

- Size and weight of item (estimated)
- Type of material in which the item was imbedded.

The remainder of the Unit D-1 area where bedrock is exposed will have been scanned and cleared two times from the ground surface. Point clearance will be performed to remove metallic anomalies, except in the paved roadways and utility stub locations. In locations where utility stubs are located, they will be exposed through excavation to verify that anomalies are associated with the utility lines.

After completion of the geophysical surveys in Unit D-1, Unit D-1 fill areas (Sector 2) will be excavated to a depth of at least 6 inches less than the reliable depth of the geophysical instrument. The excavation surface will be scanned; if anomalies are found, they will be point cleared. This procedure will be repeated until the excavation encounters bedrock or reaches the bottom of the fill. If colluvial and/or alluvial material is encountered below the fill it will be scanned and removed in lifts until bedrock is encountered or until two clear lifts have been found.

The TNT Strips will have been scanned two times from the surface. The unvegetated portion of the TNT Strips will be wetted with water and homogenized using a disc to a depth of at least 6 inches less than the reliable depth of the geophysical instrument. Field confirmation samples will be taken of the disced material. All field confirmation samples will be obtained using EPA methods or Evaluation of the Attainment of cleanup standards: Volume 1-Soils and Solid Media (U.S. Environmental Protection Agency, 1989). If the TNT concentrations are less than 10 percent by weight, the soil will be excavated and stockpiled on site. The stockpiled material will be sampled in accordance with the requirements of the landfill accepting the material before off-site disposal (see non-OE RDD). Field confirmation samples will be taken in the excavated surface. If there are any areas where concentrations of TNT are equal to or exceed 10 percent by weight, a second scan, wetting, excavation, and field confirmation sampling and removal will be performed. This process will continue until all soils with concentrations equal to or greater than 10 percent by weight has been removed from the TNT Strips.

In the areas outside the unvegetated TNT Strips where explosive concentrations exceed the cleanup levels as determined by the non-OE RDD, the soils will have been scanned twice from the ground surface. These soils will be excavated to a depth of 6 inches less than the reliable depth of detection for the geophysical instrument. The excavated soil will be sampled as required by the non-OE RDD and transported off site to an appropriate landfill. The excavation surface will be scanned; if any anomalies are found, they will be point cleared. The process of excavation scanning and point clearance will continue until the soil explosive concentrations are below the cleanup level, as determined by the non-OE RDD and no further anomalies are found by the scanning process.

The bottom of the North Valley includes the Howitzer Test Facility, Ammunition Renovation/Primer Destruction Site, the North Valley Military Landfill, and other portions of the valley floor. Portions of these areas are underlain by a relatively thin layer of soil fill (generally 3 to 5 feet, but in the landfill as deep as 8 feet). The fill areas will have been scanned two times from the surface and will be excavated to a depth of at least 6 inches less than the reliable depth of the geophysical instrument. The excavated soil will be temporarily stockpiled on site. The excavation surface will be scanned; if anomalies are found, they will be point cleared. The areas will again be excavated to at least 6 inches less than the reliable depth of the geophysical instrument. The process of excavation scanning and point clearance will continue until the excavation encounters the original ground surface or bedrock. When the original ground surface or bedrock is encountered, the original ground surface or the top of bedrock will be scanned. If anomalies are found, they will be cleared and the area will be rescanned as a final QC.

The fill soils removed from the bottom of the North Valley will be placed back in the North Valley after the valley has been prepared to accept fill. If any OE items are found during the original point clearance or during removal of the fill and scanning in lifts, the fill soils will be placed in the North Valley and QC scanned in 8-inch lifts. If no OE items are found, the fill soils will be placed without scanning. DTSC will review the results of the point clearance activities and may require scanning of the fill soils in 8-inch lifts if the reliability of the scans are in question due to the density of metallic anomalies.

Institutional controls will be applied to portions of the Project Site through a Covenant to Restrict Use of Property recorded with Solano County. The institutional controls will affect the paved streets and sidewalks in Unit D-1 and the open space parcels in the North and South Valleys, including a portion of the McAllister Drive Land Bridge. The restrictions will permanently apply to the affected areas and will restrict any excavation or other activities that would penetrate the ground. Any planned excavation in this area will require that notice be provided to the City of Benicia, DTSC, and USACE, and that the activities would only be conducted using support by UXO Technicians. The restrictions will also prevent the owners of the affected areas from obtaining any change in the land use designation or zoning for the North and South Valley open space parcels.

The exposed bedrock portion of the Ridge will be scanned two times from the ground surface. Point clearance will be performed to remove metallic anomalies, if encountered. If no OE or OE scrap is found in the in-place bedrock, the in-place bedrock is considered to be free of OE, no further scanning is proposed.

After completion of the first two geophysical surveys in Sector 5, Demolition Sites #1 and #3 will be excavated in 1-foot lifts, geophysically scanned, and the anomalies will be removed. The excavation in 1-foot lifts, scanning, and point clearance will be repeated until bedrock is encountered. Any soil outside the demolition sites that is associated with the demolition sites that has chemical concentrations exceeding the soil cleanup levels will be excavated and scanned in 1-foot lifts to depths necessary to remove the affected soil. Confirmation sampling will be used to determine depth of removal. The non-OE RDD provides details regarding the confirmation sampling program.

After completion of the first two geophysical surveys in Sector 5, the Flare Site will be excavated in 1-foot lifts, geophysically scanned, and anomalies removed. The excavation in 1-foot lifts, scanning, and point clearance will be repeated until no further anomalies are found and confirmation sampling and testing confirms that soils with chemical concentrations exceeding cleanup goals are removed. The non-OE RDD provides details regarding the confirmation sampling program.

3.4.4.3 Areawide Clearance.

The database developed from the point clearance activities will be used to refine the preliminary SCM (see Figure 3-1) for the distribution of OE and OE scrap across the Project Site. Information that will be developed into presentation maps for the refined SCM are listed in Section 3.4.4.2.

The preliminary SCM will be refined based on the surface clearance and point clearance data. Surface and subsurface OE and OE scrap will be evaluated and presentation maps will be prepared using the site geographic information to show the location, depth, orientation, condition, size, and weight of OE and OE scrap identified during the point clearance activity. DTSC, USACE, the OE contractor, and Granite will evaluate the refined SCM to determine areas of the site that have a potential to contain OE based on the OE distribution pattern. Areas of the Project Site that have been identified as areas with no potential to contain OE will be excluded from further investigation. Those areas of the site with a potential for containing OE and that are situated in a restricted area will be identified for institutional controls. Those portions of the Project Site with a potential for OE that are defined by an OE distribution pattern and that overlay an unrestricted portion of the Project Site will be identified for areawide clearance. An OE item or area that is not part of the identified pattern will be considered an outlier, and areawide clearance will be completed for the area within a 200-foot radius of the item that overlays an unrestricted portion of the Project Site (Figure 3-6).

The portions of the Project Site that are subject to areawide clearance will be excavated to a depth of at least 6 inches less than the reliable detection depth of the geophysical instrument. The resulting soil will be placed in the bottom of the North Valley and will be QC scanned in 8-inch lifts. If no OE or OE scrap is found, it will be considered a clear lift. The excavated surface will be scanned and any anomalies regardless of depth will be point cleared. The second layer will be excavated; will be placed in the bottom of the North Valley and QC scanned in 8-inch lifts. If no OE or OE scrap is found when the excavated surface is scanned or when the excavated soil is placed in the North Valley, the second layer will be considered a clear lift. If OE or OE scrap is found, then this second lift will not be considered a clear lift. Two clear lifts are required below the deepest anomaly found. The process of scanning, excavation, and QC scanning in the North Valley will continue until two consecutive clear lifts are found or bedrock is encountered. The thickness of the second and subsequent excavated soil layers will be at least 6 inches less than the reliable detection depth of the geophysical instrument. If two consecutive clear lifts are encountered and no deeper anomalies were detected or bedrock was encountered no further scanning will be required when excavating in the area or when the excavated soil is placed in the North Valley (Figure 3-7).

3.5 DATA MANAGEMENT

A Geographic Information System (GIS) has been developed to support initial investigations and site planning. This GIS will be used in the OE remedial action process to support:

- Project management
- Data management
- Data analysis
- Information storage, retrieval, and dissemination.

The project GIS will be used to manage field data. Data will undergo a series of processes in the field; the final stage is integration into the GIS. In general, the data will undergo:

- Collection using GPS, geophysical and data-logging equipment
- Post-processing using GPS software
- Data analysis using geophysical modeling software
- Data conversion using Commercial-off-the-Shelf database and other utilities that are customized specifically for this project
- Integration into the project GIS.

The project GIS will be used as a QC element of the previous steps; the GIS will verify that locations are reasonable and accurate by overlaying the GPS data on known coordinates of features; it will also be used to model a sample of the geophysical data (using a separate set of software parameters) to verify consistency.

Project GIS personnel will perform the following QA/QC procedures to ensure quality of the GIS data:

- Use standardize naming conventions for project data
- Keep records of activities performed on the project data (e.g., a daily log of operations performed)
- Keep records of metadata (e.g., a spreadsheet or database table that lists files created, their purpose, and currency)
- Use logical directory structures (folders) to store and maintain data

- Perform regular (daily/weekly) data backups/archives to minimize data loss

- Transmit relevant data to Granite/USACE/DTSC on a an as-requested frequency.

3.5.1 Reference System/Existing Geographic Information System

The GIS is based on 1998 aerial photographs flown for earlier phases of this project; these photographs were orthorectified and standardized to (approximately) 1-foot accuracy. The photographs were used to develop GIS vector data showing roads, fences, structures, 5-foot topographic contours, and other features. The coordinate system for these data is the California State Plane (CSP) Coordinate System, Zone 2, based on the NAD83 in feet.

During subsequent studies, numerous additional data layers have been integrated into the project GIS, including areas of historic activity on the Project Site (based on historic aerial photography, site maps, and other records), results of the ordnance EE/CA for the Former Benicia Arsenal (grids where sampling was performed, sampling results), locations where samples were taken for chemical analysis, etc. From these empirical data layers, additional data layers have been interpolated, including the development of proposed sampling sectors, various safety buffers based on numerous variable site characteristics, chemical concentrations (based on sampling results), etc.

3.5.1.1 Mapping and Location Surveys.

The GIS will be used during pre-field activity for purposes of planning and scheduling. Coordinates of sector boundaries, grids, and historic activity areas, will be prepared and provided to surveyors/field technicians for field staking and related preparation activities.

3.5.1.2 Public Withdrawal.

A database of local residents, businesses, and other public entities in the vicinity of the project site will be provided. This database will be linked to the project GIS so that spatial queries can be performed to identify who needs to be informed of specific activities during the field program. These queries will be used to support public withdrawals and notifications to the community.

The GIS database of local interests will also be related to project safety distances to ensure that project safety goals, MSAs, VSDs, and public withdrawals are met, as discussed in Appendix B. The MSD and VSD for each sector are shown on Figures 3-8 through 3-17.

3.5.1.3 Point Clearance.

As geophysical mapping, anomaly detection, and OE detection and removals are performed as part of the point clearances (as outlined in Chapter 4.0), the GPS data will be used to integrate the results into the project GIS. These data can then be manipulated to:

- Identify progress for project managers
- Support data QA and QC objectives
- Analyze and display OE locations, densities, and types, for technical personnel
- Display project results for public relations support.

3.5.1.4 Areawide Clearance.

Point clearance data will be evaluated to determine the distribution of OE and OE scrap at the Project Site. The distribution of OE and OE scrap will be used to determine if certain areas of the Project Site can be eliminated from the portion of the Project Site requiring areawide clearance. In preparation for the evaluation, the OE and OE scrap find locations, depths, and orientation will be plotted on a Project Site map. The dig sheets and other pertinent information, such as signs of the damage to OE from demolition and the location relative to the site features, will be documented.

The project GIS will be used to prepare the presentation maps that will be the basis of the SCM. The OE and OE scrap identified in the surface and point clearance anomalies will be included in these maps along with other data described in Section 3.4.4.3.

Figure 3-1 Project Site Minimum Separation Area

Figure 3-2 Jurisdictional Wetlands

Figure 3-3 Typical Daily Public Withdrawal Area

Figure 3-4 Voluntary Separation Distances